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Sustainable Banking, Market Power, and Efficiency: Effects on Banks' Profitability and Risk

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Abstract: The financial crisis seriously damaged the reputation of the banking sector, as well as its profitability and risk of insolvency, which led many banks to adopt a sustainable approach aimed at balancing long-term goals with short-term performance pressures. This article analyses how sustainable banking practices affect the profitability and the insolvency risk of banks. Moreover, we examine how sustainable strategies determine the effects of market power and efficiency on bank profitability. We used a two-step System-GMM to analyze an unbalanced panel of 1236 banks from 48 countries over the period 2015–2019. We found that sustainable banking practices increased profitability, and market power was an important determinant of profitability among conventional banks, but not among sustainable banks. Higher levels of cost scale efficiency led to greater profitability for both sustainable and conventional banks. However, there was no significant relationship between sustainable banking and insolvency risk. These results indicate that the traditional determinants of bank profitability are not relevant in explaining the superior profits of sustainable banks, which suggests the emergence of a new paradigm related to sustainability among the drivers of bank profitability.

Keywords: sustainable banking; market power; efficiency; profitability; risk

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1. Introduction

During the global financial crisis of 2008, the banking sector focused too much on financial results while disregarding other aspects of business, which led to the banks' failure and seriously damaged their reputation. Banks have attempted to recoup this damaged reputation and restore trust by implementing sustainable business strategies [1,2]. Sustainable practices are aimed at supporting the environment, society, and the economic benefit of the business simultaneously, which can have important effects on bank profitability [3]. Traditionally, the profitability of the banking sector has been explained mainly by two hypotheses [4]. The market power hypothesis considers that greater market concentration, or market power, facilitates the setting of higher profits for customers, which increases windfall profits for banks, while the efficiency hypothesis assumes a positive relationship between efficiency and bank profits.

Some articles have analyzed the profitability of sustainable banks [1,5,6], but none has considered how sustainable banking affects the traditional hypotheses of market power and efficiency. The first contribution of the article is thus to analyze how sustainable practices determine the effects of market power and efficiency on bank profitability. The analysis of these aspects is very important because the financial crisis not only led banks to adopt sustainable activities; it also reduced the profitability of banks, increased the concentration of the banking industry due to mergers and acquisitions, and strengthened the differences between more and less efficient banks because the former could reduce costs, avoid excessive delinquency, and get better financing conditions [7].

Sustainable business models offer competitive advantages for banks, such as better reputation and brand differentiation, which attracts more loyal customers and increases

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market share. However, it is likely that sustainable banks will not exploit their greater market power to impose higher prices on customers, as proposed by the market power hypothesis. Instead, these banks would use other competitive advantages, such as emotional factors or differentiated business cultures and values to capture customers' loyalty and boost profits [8]. We thus propose the following hypothesis:

Hypothesis 1 (H1). *The market power hypothesis is less relevant in explaining bank profitability for sustainable banks than for conventional banks.*

Conversely, sustainable practices are costly, which can have adverse effects on bank efficiency [9]. Nevertheless, sustainable actions also improve banks' reputation, which lowers their funding costs and gives them access to more investments [10,11]. Moreover, these actions also strengthen the sustainability standards of the banking industry, which raises competitors' costs [12]. Therefore, it is likely that the positive effects of sustainable strategies on bank efficiency compensate for the negative ones and, thus, sustainable banks tend to be as efficient as conventional banks. Consequently, we propose the following hypothesis:

Hypothesis 2 (H2). *The relevance of the efficiency hypothesis in explaining bank profitability is similar for both sustainable and conventional banks.*

Not only can sustainable practices determine the relationship between profitability, efficiency, and market power, but they can also affect banks' insolvency risk: the risk of a bank being unable to fulfil its obligations of repaying its debt. Although studies on the relationship between sustainability and financial performance are relatively numerous, the relationship between sustainability and bank stability has not received enough attention from researchers and remains open to debate even today [13]. The second contribution of this article is thus to analyze how sustainable banking strategies affect insolvency risk. The study of ways to reduce insolvency risk deserves special attention because during the crisis, financial institutions faced huge losses from credit defaults, high levels of uncertainty, and strong funding restrictions [14,15]. This is important as insolvency risk not only affects the bank itself, but also may influence the entire financial system [16].

Sustainable strategies can reduce insolvency risk because they improve brand image and attract customers, which lowers reputational risk [11,17]. Sustainable banks also tend to have a greater degree of transparency and higher moral standards, which mitigates adverse selection and moral hazard problems [18]. Moreover, banks with higher funding stability are more prone to invest in sustainable activities [19,20]. So, we propose the following hypothesis:

Hypothesis 3 (H3). *Sustainable banking practices lead to a reduction in bank risk.*

To test Hypotheses 1–3, we performed empirical analysis of a sample of 1236 banks from 48 countries over the period 2015–2019. We defined sustainable banks as those that voluntarily joined the United Nations Principles for Responsible Banking (UNEP Finance Initiative). The analysis was performed using the System-GMM (generalized method of moments) methodology for panel data, which makes it possible to control both unobservable heterogeneity and the problems of endogeneity through the use of instruments [21].

Our results show that sustainable initiatives lead to higher profits. Moreover, conventional banks that operate in more concentrated markets obtain superior profits, whereas this effect is not observed among sustainable banks, and a larger banking concentration does not affect their profitability significantly. On the other hand, higher levels of cost scale efficiency lead to higher profitability for both conventional and sustainable banks. Finally, sustainable strategies do not have a significant impact on insolvency risk. These results show that the traditional determinants of bank profitability are not relevant in explaining

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the superior profits of sustainable banks, which suggests the emergence of a new paradigm related to sustainability among the drivers of bank profitability.

The remainder of the article is structured as follows: Section 2 reviews the previous literature, Section 3 focuses on the empirical analysis and the discussion of the results and Section 4 presents the conclusions, followed by the bibliography and appendices on the procedures followed in calculating the efficiency and scale economies.

2. Literature Review

2.1. Sustainable Banking and the United Nations Principles for Responsible Banking

Reputation has been always important in banking due to asymmetric information, the qualitative-asset-transformation made by banks and the systemic risk created by the supply of payment and risk management services [22,23]. Since the global crisis of 2008, the banking sector has been especially affected by reputational risk. Several frauds, software failures, and the financial risks of the crisis of 2008 have not helped to improve the negative perceptions among customers and other stakeholders, and have increased skepticism of commercial banks' motives and actions [1,24].

A possible way to improve banks' reputation and restore credibility would be to promote banks' engagement in sustainable activities, which implies integrating environmental protection, social responsibility and financial benefit into management and business operations [25]. Sustainable development has been the priority of many international organizations, but probably one of the most important steps was made in 2015 by the United Nations (UN) with the adoption of Sustainable Development Goals (SDGs) to address several global challenges by the target date of 2030, including the reduction of poverty, inequality, illiteracy, climate change, and environmental degradation, as well as the defending of human rights and dignity.

The banking sector can play a crucial role in achieving these goals because its involvement in sustainable activities has a potential impact on the sustainability of other industries through the lending channel [26,27]. For instance, banks can be directly involved in projects that protect the environment (green finance), orient funds according to the environmental risk of the target companies or promote socially responsible products [28]. Banks can also offer micro-loans and mobile banking to promote financial inclusion and alleviate poverty, or they can provide women's microcredit to contribute to gender equality [3].

Conscious of these aspects, the UN launched the Principles for Responsible Banking (UNEP Finance Initiative), which banks can voluntarily sign, in September 2019. The purpose of this initiative is to increase lending that supports socially and environmentally sustainable economic activities through six principles that signatory banks must implement within four years [29]. The six principles are, first, alignment: banks must align their business strategy to SDGs, the Paris Climate Agreement and relevant national and regional frameworks. Second, impact and target setting: banks must continuously assess the impact of their activity on people and the environment; moreover, banks have to set and publish targets where they have the most significant impacts. Third, clients and customers: banks must develop sustainable practices with clients and customers and enable economic activities that create prosperity for current and future generations. Fourth, stakeholders: to achieve society's goals, banks must responsibly consult, engage, and partner with relevant stakeholders. Fifth, governance and culture: banks must implement effective governance and a culture of responsible banking. Finally, transparency and accountability: banks must periodically review the six principles and be transparent about and accountable for their impacts and contributions to society's goals. The signatories´ progress on these principles is reviewed every year and banks that cannot evidence the necessary changes will lose their status as a signatory.

Apart from the previous obligations, the UNEP Finance Initiative also provides several benefits to its signatories [29]. First, the six principles offer unparalleled opportunities for collaboration within the banking sector. Signatories to the Principles for Responsible Banking benefit from the collective expertise of the largest community of sustainable

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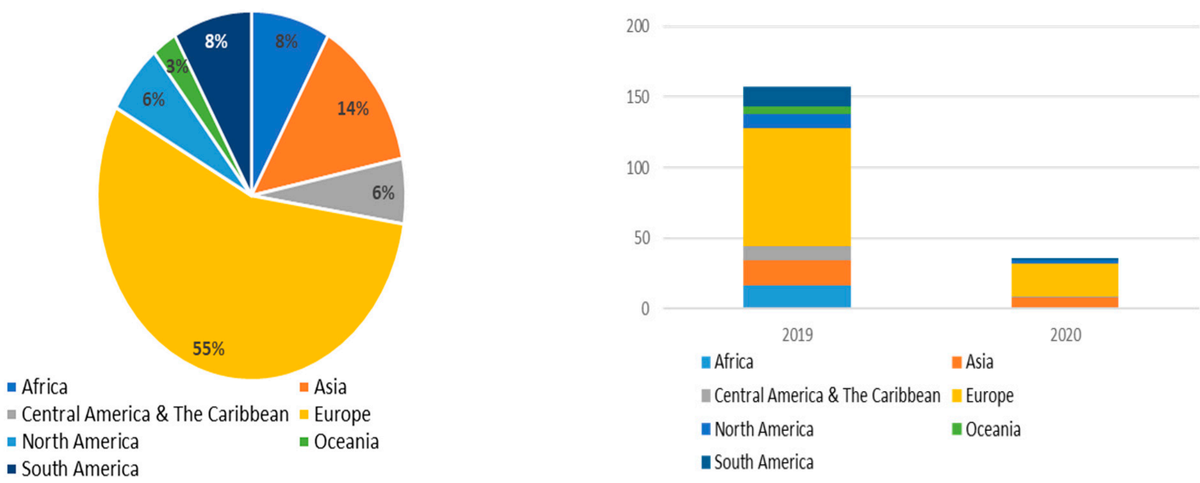
bankers globally. By working collaboratively under the auspices of the UN, signatory banks jointly deliver tools, methodology and practical guidance far beyond what any conventional bank could achieve on its own. This collaboration is based on 11 Working Groups composed of representatives from across the signatory banks. Each focuses on a different aspect of implementation, including: impact analysis, knowledge sharing, target setting and progress evaluation. These outputs are uniquely positioned to shape global best practice and influence emerging regional regulation. Moreover, collective initiatives create the space for banks to jointly push beyond current practice and define new standards for sustainability leadership. Second, unlike conventional banks, all signatory banks have access to an individual feedback and support provided by the UNEP Finance Initiative. This takes a look across their business and makes recommendations on steps the banks can take to further progress their implementation of the principles. Third, signatory banks are able to access additional tools and resources for implementation that are not available for conventional banks. For instance, the Communications Toolkit is designed to assist signatories with communicating and promoting the Principles for Responsible Banking, and includes infographics, social media cards, graphics and other materials. On the other hand, the Peer Learning Repository allows peers sharing their approaches to implementing the Principles for Responsible Banking.

In short, banks have opted to become signatories because they recognize that the needs and demands of their clients and stakeholders are shifting. By implementing the Principles for Responsible Banking, banks can create sustainability value for society, as well as serve their business interests. Starting with only 30 founding signatory banks, the UNEP Finance Initiative included 193 banks from 56 countries by October 2020, including top international banks, regional leaders, development banks, and specialized environmental banks. Figure 1a represents the geographical distribution of these banks. More than 50% of the signatory banks come from Europe, followed by Asia, but with a much lower representation (14%). The remaining world regions account for about the 30% of the signatory banks. Africa and South America represent 8% each; North America and Central America and the Caribbean account for 6% each; and Oceania contains 3% of the signatory banks. In terms of the year of joining the initiative, 157 banks representing more than 80% of the signatories joined the initiative in 2019. During 2020, only 36 banks were added, mainly from Asia and Europe (see Figure 1b).



(**a**) (**b**)

Figure 1. (**a**) Geographical distribution of signatory banks of the United Nations (UN) Principles for Responsible Banking; (**b**) Number of banks by year of signature of the UN Principles for Responsible Banking.

Table 1 shows that more than half of the European signatories come from Norway, Spain, the United Kingdom, France, and Germany; in Asia, more than half of the member banks are headquartered in Japan, South Korea, and China. Most of the African banks

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operate in Nigeria, Egypt, and South Africa; and in South America, signatory banks are concentrated in Ecuador and Brazil. More than 70% of member banks in North America come from Canada and Mexico, whereas in Central America and the Caribbean, this percentage is represented by Panama, El Salvador, and Costa Rica. In Oceania, only Australian banks have joined the UN initiative.

Table 1. Countries that have joined the UN Principles for Responsible Banking.

Region/Country	No. of Banks	Region/Country	No. of Banks
EUROPE	107	AFRICA	16
Norway	18	Nigeria	5
Spain	11	Egypt	4
United Kingdom	9	South Africa	3
France	8	Kenya	1
Germany	8	Mauritius	1
Switzerland	6	Morocco	1
Netherlands	5	Togo	1
Turkey	5	ASIA	26
Denmark	4	Japan	7
Finland	4	South Korea	5
Greece	4	China	4
Italy	4	Bahrain	2
Sweden	4	Malaysia	2
Iceland	3	Bangladesh	1
Belgium	2	India	1
Ireland	2	Mongolia	1
Luxembourg	2	Myanmar	1
Russia	2	Philippines	1
Bulgaria	1	Thailand	1
Estonia	1	NORTH AMERICA	12
Liechtenstein	1	Mexico	5
Portugal	1	Canada	4
Slovenia	1	United States	3
Ukraine	1	SOUTH AMERICA	16
CENTRAL AMERICA and THE CARIBBEAN	11	Ecuador	8
Panama	4	Brazil	4
Costa Rica	2	Argentina	2
El Salvador	2	Colombia	1
Dominican Republic	1	Paraguay	1
Nicaragua	1	OCEANIA	5
Trinidad and Tobago	1	Australia	5

2.2. *Sustainable Banking, Market Power, Efficiency, and Profitability*

Joining sustainable initiatives, such as the UNEP Finance Initiative, implies integrating social, environmental, and economic aspects, which can have important effects on banks' profitability. Indeed, many articles have shown that the involvement in sustainable activities improves bank profitability [1,5,6,30]. Traditionally, the profitability of the banking sector has been explained through two main theories: the market power hypothesis and the efficiency hypothesis.

The market power hypothesis considers that greater market concentration or market share facilitates setting higher prices to customers, thereby increasing extraordinary profits [4]. This hypothesis has two versions: the structure-conduct-performance (SCP) hypothesis and the relative market power (RMP) hypothesis. The SCP considers that the greatest profits come from highly concentrated markets due to competition concerns and the existence of entrance barriers [31]. The RMP proposes that only banks with significant market share and differentiated products can exercise effective market power [32].

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The efficiency hypothesis suggests that more efficient banks have lower unit costs, so they can attract more customers, because lower unit costs would make it possible to set lower interest rates for loans and higher interest rates for deposits [4,33]. The origin of this greater efficiency could come from superior management skills and production technology (X-efficiency hypothesis) or scale economies (scale-efficiency hypothesis). Both the market power and efficiency hypotheses have found wide empirical support [7,34–38].

Sustainable business models can boost market share because socially and environmentally responsible actions improve reputation, confidence, and customer loyalty [39,40]. Consumers of sustainable products and services are more loyal because they not only care about the consumption experience, but also want to form part of a community or wish to belong to a social group when purchasing goods [41]. This loyalty is especially relevant in the financial sector, because competition is normally very intense, and customers have close business relationships with their banks [42].

Bussoli et al. [43] have shown that social initiatives by European financial institutions capture the trust and the loyalty of customers, while Yip and Bocken [44] and Agirre-Aramburu and Gómez-Pescador [2] have reported the same evidence for the banking industry in Hong Kong and Spain, respectively. Apart from social initiatives, environmental initiatives are also very welcome among customers, and many banks now provide green financial products. Fay [45] has shown that green customers buy more products and spend more when doing so. Mason [46] has argued that green customers are willing to pay a premium price for environmentally friendly products, so banks that finance firms that make such products may indirectly benefit from this green premium. Furthermore, Sun et al. [47] have reported that green banking initiatives strengthen the relationship between corporate social responsibility and consumer loyalty.

According to the market power hypothesis, a larger market share facilitates the setting of higher prices to customers, which increases windfall profits for banks. However, sustainable banks tend not to take direct advantage of their greater market share to impose higher prices for customers. Instead, their competitive advantage is based on emotional factors, such as an appreciated difference in business principles and culture or better scores in non-financial performance indicators than conventional banks [2]. This is because sustainable banks are less concerned with short-term profit-maximization and are rather oriented towards maximizing stakeholder value and client satisfaction by decreasing the harmful effects of economic activities on the environment and society [48].

Matute-Vallejo et al. [8] have found that customers in the banking industry do not perceive a bank's sustainable engagement as an attempt to instrumentalize social issues in a manner ultimately intended to increase prices. The Global Alliance for Banking on Values (GABV) [49,50] has also found evidence that sustainable banks are more profitable because they attract more deposits and provide more loans than conventional banks. However, their returns are more stable, which reinforces their focus on long-term profitability instead of obtaining immediate rents through higher prices. In this regard, as we proposed in our Hypothesis 1 (H1) in the Introduction section of the article, we expect that sustainable banking practices will weaken the market power hypothesis.

Although the relevance of the market power hypothesis may vary across sustainable and conventional banks, in terms of the efficiency hypothesis, however, the differences between both types of banks would be less pronounced. Sustainable strategies still raise concern among bank managers because the fulfilment of sustainable responsibilities could be at the expense of increased costs and reduced efficiency [25]. Sustainable banks can risk losing efficiency if they put too much emphasis on social and environmental investments [9]. Furthermore, trying to satisfy all stakeholders could adversely affect profitability due to inefficient use of resources [51,52].

Conversely, sustainable practices can also be valuable assets that contribute directly to the recovery of bank efficiency. First, a good, strong relationship with all stakeholders can help sustainable banks find more investments and help them access and use resources more efficiently [10,53]. Second, sustainability may boost banks' reputation and customer

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loyalty, which in turn would translate into lower funding costs [11,54]. For instance, green bonds have lower yields and superior ratings than conventional bonds because investors reward environmentally responsible actions [55]. Third, sustainable activities can also help banks to improve efficiency in relation to their competitors. If a bank implements these activities, future industry sustainable standards are strengthened, which raises competitors' costs [12,56]. Moreover, banks pursuing a proactive sustainable strategy are most likely the ones with greater financial resources and superior management capabilities [57,58]. In this regard, sustainable banks can increase motivation and retention, as employees react positively to the opportunity to weave environmental and social dimension into their work [59]. Therefore, it is likely that these positive effects of sustainable activities on bank efficiency offset the negative ones and, thus, sustainable banks would tend to be as efficient as conventional banks. We therefore propose that the efficiency hypothesis is similar across conventional and sustainable banks, as we suggested in our Hypothesis 2 (H2).

2.3. Sustainable Banking and Risk

Apart from affecting bank profitability, market share, and efficiency, sustainable activities can also have effects on bank risk. These effects are very important because a healthy banking system is the key to sustainable prosperity, and the security and the soundness of banks can create different external benefits for society [60]. Sustainable strategies can thus lead to a reduction in bank risk, as we proposed in our Hypothesis 3 (H3), for several reasons.

First, by becoming sustainable, banks state that their goal is to link decisively the fulfilment of local community needs with environment protection and sound economic prospects [48]. In achieving this goal, they try to avoid excessive risk taking and better manage risks [61,62]. Rajput and Oberoi [63] have shown that establishing good relationships with the community increases local support and attracts customers, thereby reducing bank risk. Other authors revealed that, by implementing environmentally friendly actions, banks reduce their reputational risk and increase customer loyalty, which leads to higher funding stability [11,17].

Second, a higher level of sustainable activism is associated with higher quality of earnings, a greater degree of transparency and higher moral standards. These factors help banks to mitigate adverse selection and moral hazard problems, which are among the main causes of non-performing loans [18,64]. Saïdane and Abdallah [13] have shown that sustainable banks in Europe are better able to absorb shocks and reduce the risk of insolvency. Moreover, Scholtens and van't Kloose [16] have found that banks with high sustainability scores, especially the social dimension, have lower default risk, as well as lower contribution to financial system risk. Cui et al. [65] have revealed that allocating more green loans to the total loan portfolio reduces the non-performing loan ratio of Chinese banks. Gangi et al. [28], for a sample of 35 countries between 2011 and 2015, have found that banks that are more sensitive to environmental issues also exhibit less risk. The measurement and impact of environmental issues on banking risk has received special attention because crises will increasingly arise from the sheer scale of systemic environmental risks with global effects [66]. Climate-related risks have been identified by the European Central Bank (ECB) as a key risk driver on the Single Supervision Mechanism (SSM) Risk Map for the euro area banking system, and the European Banking Authority (EBA) has been given several mandates to assess how environmental, social, and governance (ESG) risks can be incorporated into the three pillars of prudential supervision [67].

Third, sustainability initiatives normally come from less risky banks. The availability of financial resources incites banks to invest in environmental or social projects, so financial stability is an important condition for investing in responsible activities [19,20]. The GABV [49,50] has found that sustainable banks have stronger capital positions and lower levels of return volatility. Furthermore, Chollet and Sandwidi [68] have reported a virtuous circle between sustainability and risk. In this regard, good social and governance

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performance reduces financial risk and thereby reinforces commitment to good governance and environmental practices.

3. Empirical Analysis

3.1. Selection of the Sample

To test the Hypotheses 1–3 proposed previously, we conducted an empirical analysis, which is reported in this section. To select the sample for the analysis, we started with all of the banks in the S&P Capital IQ database (S&P Global Market Intelligence). First, we eliminated banks with no available data. Then, we removed banks with errors in their financial statements or when their values were unreasonable, such as those with negative values for total assets, total liabilities, equity, loans, deposits, interest, and non-interest, as well as operating expenses, investment securities, fixed assets, total employees, and efficiency.

We also excluded banks with data available for less than four consecutive years between 2015 and 2019, and countries without the necessary macroeconomic data. The former condition is essential to test for second-order serial correlation, which is performed to ensure the robustness of the estimates made by System-GMM [21]. Moreover, this sample period covers all of the years since the UN's adoption of SDGs. Finally, to avoid bias and spurious correlations between macroeconomic variables and bank level variables, we removed the countries with fewer than five banks in the sample [69].

The final sample consisted of an unbalanced panel of 1236 banks from 48 countries (Austria, Bangladesh, Belgium, Bolivia, Brazil, Bulgaria, Canada, China, Colombia, Costa Rica, Croatia, the Czech Republic, Denmark, Egypt, France, Germany, Greece, Hong Kong, Hungary, Indonesia, Ireland, Israel, Italy, Latvia, Luxembourg, Malaysia, the Netherlands, Nigeria, Norway, Oman, Pakistan, Peru, the Philippines, Poland, Portugal, Romania, Russia, Saudi Arabia, Serbia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States, and Vietnam) between 2015 and 2019 (5915 observations). Table 2 shows the number of banks and observations for each country and the temporary distribution of the sample. The financial information on each bank comes from the S&P Capital IQ database (Global Market Intelligence). The macroeconomic information comes from the International Monetary Fund database and the World Bank's World Development Indicators.

Table 2. Sample description.

Panel A: Number of Banks and Observations per Country					
Country	**No. of Banks**	**No. of Obs.**	**Country**	**No. of Banks**	**No. of Obs.**
Austria	32	153	Luxembourg	7	33
Bangladesh	11	53	Malaysia	8	39
Belgium	8	39	Netherlands	9	44
Bolivia	5	24	Nigeria	13	52
Brazil	15	70	Norway	17	82
Bulgaria	8	38	Oman	5	20
Canada	7	34	Pakistan	21	103
China	98	459	Peru	9	44
Colombia	14	68	Philippines	6	29
Costa Rica	9	44	Poland	8	39
Croatia	10	45	Portugal	8	39
Czech Republic	10	50	Romania	9	41
Denmark	8	40	Russia	6	29
Egypt	9	36	Saudi Arabia	12	59
France	81	385	Serbia	6	29

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Table 2. *Cont.*

Panel A: Number of Banks and Observations per Country					
Country	**No. of Banks**	**No. of Obs.**	**Country**	**No. of Banks**	**No. of Obs.**
Germany	105	500	Slovenia	7	33
Greece	6	30	South Africa	7	31
Hong Kong	9	44	Spain	20	98
Hungary	6	28	Sweden	8	37
Indonesia	40	193	Switzerland	41	197
Ireland	6	30	Turkey	8	38
Israel	6	29	United Kingdom	34	167
Italy	41	182	United States	402	1961
Latvia	11	51	Vietnam	10	46
Number of total banks and Obs.				1236	5915
Panel B: Temporary Disribution of the Sample					
	2015	2016	2017	2018	2019	**Total Obs.**
No. of Obs.	1129	1236	1236	1236	1078	**5915**

Obs.: Observations.

3.2. Profitability Analysis

3.2.1. Econometric Model of the Profitability Analysis

To perform the profitability analysis, we followed Berger [4], who proposed the estimation of the market power and efficiency hypothesis through a single equation. To evaluate these hypotheses for sustainable and conventional banks and to test the differences between both types of banks we proposed the following model:

$$R_{i,t} = \beta_0 + \beta_1 SB_i + (\beta_2 + \beta_3 SB_i) \times CONC_{m,t} + (\beta_4 + \beta_5 SB_i) \times MS_{i,t} + (\beta_6 + \beta_7 SB_i) \times XEF_{i,t} + (\beta_8 + \beta_9 SB_i) \times SEF_{i,t} + \beta_{10} EQUITY_{i,t} + \beta_{11} LOANS_{i,t} + \beta_{12} SIZE_{i,t} + \beta_{13} \Delta GDP_{m,t} + \sum^{T}{}_{t=1} YEAR_t + \sum^{M}{}_{m=1} COUNTRY_m + \varepsilon_{i,t} \quad (1)$$

The dependent variable ($R_{i,t}$) is a measure of the profitability of banks: ROA (return on assets) and ROE (return on equity). ROA is the ratio of net income over total assets and captures the earnings that were generated from invested capital (assets). ROE measures how profitable a bank is for its owners and represents the ratio of net income over shareholder equity. So, ROA only depends on the ability of assets to generate income, whereas ROE also depends on how these assets are financed (the level of equity and debt). These measures are the most widely used in the literature [4,7,36,70].

SB is a dummy variable that serves to capture sustainable banks. It takes the value of 1 for the banks that have signed the UN Principles for Responsible Banking, and 0 otherwise. Many articles have shown that sustainable banks are more profitable because customers reward socially and environmentally responsible actions [1,5]. Therefore, we expect that the variable SB will have a significant and positive coefficient.

CONC is the market concentration. We used the Herfindahl–Hirschman index (HHI), which is the sum of the squared market share, measured in terms of assets, of all of the banks operating in a market [71–73]. For each country, this index was estimated using all of the banks listed in the S&P Capital IQ database [7,34]. MS is the market share, measured in terms of assets, of bank i at time t [7,35]. XEF and SEF are our measures of efficiency in terms of cost. Cost efficiency is the ratio between the minimum cost at which it is possible to attain a given volume of production and the realized cost. Efficiency ranges over the [0,1] interval, and equals 1 for the best-practice bank in the sample [74]. More precisely, XEF is the cost X-efficiency of bank i at time t. We estimated the Fourier flexible cost function by applying the stochastic frontier approach (SFA) to measure this variable [7,75] (See Appendix A for a description of the procedure for calculating X-efficiency). SEF is the scale efficiency of bank i at time t. We derived the Fourier flexible cost function, with respect to the inputs, to measure this variable [7,76] (See Appendix B for a description of the procedure for calculating scale economies).

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To analyze how sustainable banks determine the effects of market power and efficiency on profitability, in Equation (1) we included the interaction terms between the sustainable banks dummy (SB) and the variables CONC, MS, XEF, and SEF (SB × CONC, SB × MS, SB × XEF, and SB × SEF). The effects that CONC had on the profitability of conventional banks (SB = 0) were measured by the coefficient β2. In the case of MS, XEF, and SEF, these effects were captured by the coefficients β4, β6, and β8, respectively. For sustainable banks (SB = 1), the effect of CONC on profitability was measured by the sum of the coefficients (β2 + β3). In the case of MS, XEF, and SEF, this effect was reflected by the sums of the coefficients (β4 + β5), (β6 + β7), and (β8 + β9), respectively.

Conventional banks that operate in more concentrated banking markets or that have a greater market share can obtain non-competitive rents by setting higher prices for customers, so we expect that the coefficients β2 and β4 will have a positive and significant sign [4,31]. Nevertheless, sustainable banks do not normally exploit their greater market share to impose higher prices for clients and their competitive advantage is more based on the emotional factors of their business culture [2,8]. Therefore, the sums of the coefficients (β2 + β3) and (β4 + β5) are expected to be non-significant.

More efficient conventional banks have lower unit costs, so they can attract more customers [4,33]. Therefore, we expect that the coefficients β6 and β8 will have a significant and positive sign. Sustainable practices have both positive and negative effects on efficiency, which is why sustainable banks tend to be as efficient as conventional banks [9,11]. As a result, we expect that the sums of the coefficients (β6 + β7) and (β8 + β9) will have a significant and positive sign also.

EQUITY is the ratio of equity over total assets and serves to capture the risk of insolvency [7]. Banks with lower levels of equity bear higher borrowing costs, which reduces net interest margins and profits [70]. Moreover, banks with higher equity can take advantage of business opportunities more effectively and thus receive a higher return [77]. Therefore, we expect a positive relationship between EQUITY and bank profitability.

The LOANS variable is the ratio of loans to total assets and captures the liquidity risk of the bank and its activity [78,79]. Loans, especially those granted to households and companies, are risky and have a higher expected return than other bank assets such as government securities. Therefore, a positive relationship between LOANS and profitability can be expected [78]. However, another approach suggests that the lower the funds allocated to liquid investments, the higher the profitability obtained [80]. As a result, we can also expect a negative relationship between LOANS and profitability.

SIZE represents the size of the bank and is calculated as the natural logarithm of total assets (deflated) [81,82]. Economies of scale can arise from a larger size, which increases operational efficiency and reduces costs [83]. Therefore, a positive relationship between SIZE and profitability can be expected. Nevertheless, agency costs and bureaucratic expenses tend to be higher in the management of large banks [84]. Consequently, the relationship between SIZE and profitability could also be negative.

ΔGDP represents the Gross Domestic Product (GDP) per capita growth (annual %) and captures the economic cycle [38]. Better economic conditions raise the demand for credit, which boosts bank profitability [77,85]. Therefore, we expect that the GDP growth will have a significant and positive coefficient. Table 3 provides a summary of the independent variables included in Equation (1) and their expected relationships with profitability.

Finally, year- and country-effect dummies were included to capture year- and country-specific factors. The error term is $\varepsilon_{i,t}$, and i = 1, 2, . . . , N indicates a specific bank i; t = 1, 2, . . . , T indicates a particular year t; and m = 1, 2, . . . , M indicates a particular country m. Table 4 presents the descriptive statistics of the variables used in the profitability analysis, and Table 5 depicts the correlation between these variables. The software used to evaluate the statistical parameters and the whole empirical models is STATA (version 12). STATA is a program that enables users to analyze, manage, and produce statistical data, and is primarily used by researchers in the fields of economics, biomedicine, and political science.

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Table 3. Summary of the independent variables of the profitability analysis.

Variable	Description	Expected Relationship with Profitability (R)
SB	Dummy that takes the value of 1 if a bank has signed the UN Principles for Responsible Banking, and 0 otherwise	Positive
CONC	Herfindahl-Hirschman index (HHI) in terms of assets	Positive
MS	Market share in terms of assets	Positive
XEF	Cost X-efficiency	Positive
SEF	Scale efficiency with respect to the inputs	Positive
SB × CONC	Interaction between sustainable banks and market concentration	Non-significant
SB × MS	Interaction between sustainable banks and market share	Non-significant
SB × XEF	Interaction between sustainable banks and cost X-efficiency	Positive
SB × SEF	Interaction between sustainable banks and scale efficiency	Positive
EQUITY	Equity/Total assets	Positive
LOANS	Loans/Total assets	Positive/Negative
SIZE	Log (Total assets)	Positive/Negative
ΔGDP	GDP per capita growth	Positive

Table 4. Sample statistics of the profitability analysis.

Variable	Mean	Standard Deviation	Minimum	Maximum
ROA	0.0072	0.0086	−0.1173	0.1491
ROE	0.0731	0.0786	−0.9124	0.7087
CONC	0.0792	0.0524	0.0306	0.2914
MS	0.0261	0.0570	1.69×10^{-6}	0.4602
XEF	0.8161	0.0579	0.3896	0.9470
SEF	0.7455	0.0998	0.0041	0.7813
EQUITY	0.0996	0.0458	0.0192	0.7450
LOANS	0.6340	0.1596	0.0195	0.9747
SIZE	8.9409	2.0031	3.1179	14.7620
ΔGDP	2.1572	1.9563	−4.3515	23.9855

Table 5. Correlations of the profitability analysis.

	CONC	MS	XEF	SEF	EQUITY	LOANS	SIZE	ΔGDP
CONC	1							
MS	0.5002	1						
XEF	−0.0792	−0.0906	1					
SEF	−0.0137	−0.2421	−0.0101	1				
EQUITY	0.0153	−0.0315	0.0301	0.1302	1			
LOANS	−0.1249	−0.1222	0.1223	0.1928	−0.0004	1		
SIZE	0.2204	0.4497	−0.0141	−0.4382	−0.2631	−0.1559	1	
ΔGDP	−0.0486	−0.0053	−0.0032	−0.0051	−0.0679	−0.2236	0.0350	1

3.2.2. Methodology

The model in Equation (1) was estimated using a two-step System-GMM with robust errors, which is consistent in the presence of any pattern of heteroscedasticity and autocorrelation. This method allows for controlling the problems of endogeneity and delivers consistent and unbiased estimates by using lagged independent variables as instruments [21]. Additionally, the System-GMM estimator provides stronger instruments and lower bias, by considering both first-differenced and levels equations [86]. This methodology is especially useful in samples that are based on a short time scale and a larger number of countries, as it was our case [87,88]. The GDP growth and the year and country dummies were considered exogenous, while the remaining variables were considered endogenous. Based on the Hansen test of the over-identifying restrictions for endogenous variables, in general second

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and third lags were used as instruments. The variables EQUITY in levels and CONC in both levels and differences showed over-identification problems according to the Hansen test. To address this issue, we used third lags for the variables EQUITY and CONC (in levels), and fourth lags for the variable CONC (in differences). The exogenous variables were instrumented by themselves.

The large number of endogenous variables in our estimation means that we had many instruments and could inadvertently overfit our endogenous variables. To reduce this possibility, we collapsed the instruments used in our estimation. With the collapse option, one instrument is created for each variable and lag distance, rather than one for each time period, variable, and lag distance. Bowsher [89] found that the use of too many moment conditions can significantly reduce the power of tests of over-identifying restrictions. The collapse option effectively constrains all of the yearly moment conditions to be the same and reduces the instrument count and the number of moment conditions used in the difference-in-Hansen test of exogeneity instrument subsets, which makes this test more powerful [90,91]. Many articles have collapsed the instruments used in the System-GMM estimation [69,92,93].

Finally, we studied each endogenous variable separately to assess whether the instruments provide significant explanatory power over the endogenous variables, focusing on the F-statistics from the first-stage OLS regressions. We ran two different regressions for each endogenous variable: one for the equations in differences (where the instruments are in levels), and the other for the equations in levels (where the instruments are in differences). For the System-GMM regressions, this test is merely indicative of the strength of the instruments since consistency of the GMM estimates relies on the joint estimation of both the levels and the difference equations. Other articles also calculated the F-statistics to analyze the strength of the instruments for System-GMM estimations [92,94,95].

Table 6 shows the results of this analysis. In general, the F-statistics for the first-stage regressions are significant and higher than 10, which is the critical value suggested by Staiger and Stock [96] for assessing instrument strength. It implies that the instruments provide significant explanatory power for the endogenous variables.

Table 6. First-stage OLS regressions for System-GMM estimates (profitability analysis).

R	F-Statistic	*p*-Value	R^2
Panel A. Dependent variable in levels, explanatory variables (instruments) in differences			
SB	254.4	0.0000	0.9832
CONC	10.9	0.0010	0.4071
SB × CONC	57	0.0000	0.9134
MS	43.6	0.0000	0.5870
SB × MS	58.5	0.0000	0.7957
XEF	28.5	0.0000	0.1375
SB × XEF	58.6	0.0000	0.9858
SEF	16.3	0.0000	0.5226
SB × SEF	6.5	0.0016	0.9371
EQUITY	94	0.0000	0.1873
LOANS	13.3	0.0000	0.1419
SIZE	1.9	0.1456	0.4103
Panel B. Dependent variable in differences, explanatory variables (instruments) in levels			
ΔSB	22,222.9	0.0000	0.9344
ΔCONC	33.9	0.0000	0.4108
Δ(SB × CONC)	39.8	0.0000	0.5180
ΔMS	67.1	0.0000	0.4418
Δ(SB × MS)	6.9	0.0010	0.4927
ΔXEF	30.1	0.0000	0.1146
Δ(SB × XEF)	87.3	0.0000	0.2539

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Table 6. *Cont.*

R	F-Statistic	*p*-Value	R^2
ΔSEF	59.5	0.0000	0.3644
Δ(SB × SEF)	75.7	0.0000	0.4049
ΔEQUITY	20	0.0000	0.0739
ΔLOANS	42	0.0000	0.0853
ΔSIZE	85	0.0000	0.2191

3.2.3. Results of the Profitability Analysis

Table 7 shows the results of the profitability analysis. In Table 7, model (a), we analyzed ROA, and in Table 7, model (b), we examined ROE. In both models the dummy variable SB shows a significant and positive coefficient, so sustainable banks obtain higher levels of profitability.

Table 7. Results of the profitability analysis.

	ROA (a)				ROE (b)			
	Coefficient	Standard Error	T-Student	*p*-Value	Coefficient	Standard Error	T-Student	*p*-Value
SB	0.0007	0.0002	3.14	0.002 ***	0.0086	0.0032	2.71	0.007 ***
CONC	0.0357	0.0216	1.66	0.098 *	0.5286	0.2004	2.64	0.008 ***
SB × CONC	−0.0407	0.0388	−1.05	0.295	−0.3207	0.3826	−0.84	0.402
MS	0.0294	0.0172	1.71	0.087 *	0.1422	0.1366	1.04	0.298
SB × MS	−0.0062	0.0359	−0.17	0.864	0.1472	0.2637	0.56	0.577
XEF	0.0178	0.0166	1.08	0.282	0.0336	0.1363	0.25	0.805
SB × XEF	0.0002	0.0072	0.02	0.982	−0.0235	0.0725	−0.32	0.746
SEF	0.0120	0.0069	1.74	0.081 *	0.1679	0.0996	1.69	0.092 *
SB × SEF	0.0036	0.0109	0.33	0.740	−0.0015	0.1004	−0.02	0.988
EQUITY	0.0427	0.0169	2.52	0.012 **	0.0060	0.1713	0.04	0.972
LOANS	0.0020	0.0044	0.46	0.646	−0.0001	0.0548	−0.00	0.999
SIZE	−0.0001	0.0007	−0.12	0.904	0.0066	0.0086	0.77	0.441
ΔGDP	0.0003	0.0002	2.09	0.036 **	0.0030	0.0016	1.89	0.058 *
LR Test. SB × CONC	−0.0050	0.0384	−0.13	0.896	0.2078	0.4117	0.50	0.614
LR Test. SB × MS	0.0233	0.0266	0.88	0.381	0.2894	0.2338	1.24	0.216
LR Test. SB × XEF	0.0180	0.0087	0.86	0.390	0.0101	0.1614	0.06	0.950
LR Test. SB × SEF	0.0156	0.0209	1.80	0.071 *	0.1664	0.0861	1.93	0.053 *
CONS	−0.0258	0.0181	−1.42	0.154	−0.1823	0.2059	−0.89	0.376
Year dummies			Yes				Yes	
Country dummies			Yes				Yes	
M2				0.654				0.599
Hansen				0.133				0.168

*** indicates a level of significance of 0.01, ** indicates a level of significance of 0.05, * indicates a level of significance of 0.1. LR Test. SB × CONC is the linear restriction test of the sum of the coefficients associated with SB and CONC. LR Test. SB × MS is the linear restriction test of the sum of the coefficients associated with SB and MS. LR Test. SB × XEF is the linear restriction test of the sum of the coefficients associated with SB and XEF. LR Test. SB × SEF is the linear restriction test of the sum of the coefficients associated with SB and SEF. CONS is the regression intercept. M2 is the p-value of the 2nd order serial correlation statistic. Hansen is the *p*-value of the over-identifying restriction test.

The variable CONC, which measures the effects of banking concentration on the profitability of conventional banks (SB = 0), has a significant and positive coefficient in Table 7, models (a) and (b). Therefore, conventional banks that operate in more concentrated markets can exercise effective market power and obtain more profitability, as the market power hypothesis suggests. To capture the effects of concentration on the profitability of sustainable banks (SB = 1), we carried out the linear restriction test of the sum of the coefficient associated with CONC and the coefficient associated with the interaction between SB and CONC (represented in Table 7 by LR Test. SB × CONC). This linear restriction test is not significant in any of the models, which would support our Hypothesis 1.

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The variable MS, which measures the effects of market share on the profitability of conventional banks (SB = 0), is significant and positive in Table 7, model (a), but not in Table 7, model (b). Conventional banks with higher market share can probably exercise effective market power and obtain more profits, but this evidence is not conclusive across estimations. In any case, market share does not affect the profits that sustainable banks make because the linear restriction test of the sum of the coefficient associated with MS and the coefficient associated with the interaction between SB and MS (represented in Table 7 by LR Test. SB × MS) is not significant in any of the models.

The variable SEF, which measures the effects of scale efficiency on the profitability of conventional banks (SB = 0), is positive and significant in Table 7, models (a) and (b). Moreover, the LR Test. SB × SEF, which captures the previous effect for sustainable banks (SB = 1), is positive and significant in both models, too. Consequently, banks with better scale efficiency are more profitable, regardless of their sustainable orientation, which would support our Hypothesis 2.

Regarding the control variables, the variable ΔGDP is significant with a positive sign, so the economic growth boosts bank profitability as other studies suggest [77,85]. The variable EQUITY has a significant and positive coefficient in Table 7, model (a), but is not significant in Table 7, model (b), so in our sample, there is no conclusive evidence of the effects of equity on bank profitability.

3.3. Risk Analysis

3.3.1. Econometric Model of the Risk Analysis

To analyze the relationship between risk and sustainable banking practices, we proposed the following model that is based on the study of Sanfilippo-Azofra et al. [7]:

$$Z_{i,t} = \beta_0 + \beta_1 SB_i + (\beta_2 + \beta_3 SB_i) \times CONC_{m,t} + (\beta_4 + \beta_5 SB_i) \times MS_{i,t} + (\beta_6 + \beta_7 SB_i) \times XEF_{i,t} + (\beta_8 + \beta_9 SB_i) \times SEF_{i,t} + \beta_{10} LOANS_{i,t} + \beta_{11} SIZE_{i,t} + \beta_{12} LOANDEP_{i,t} + \sum^{T}{}_{t=1} YEAR_t + \sum^{M}{}_{m=1} COUNTRY_m + \varepsilon_{i,t} \quad (2)$$

The dependent variable ($Z_{i,t}$) is the Z-score, measured as follows:

$$Z_{i,t} = (ROA + K/A)/\sigma ROA$$

where ROA is the return on assets, K is the equity capital, A is the total assets, and σROA is the standard deviation of ROA. The Z-score is widely used to measure a bank's risk [7,28,97,98]; the higher the Z-score, the lower the probability of bankruptcy.

As above, SB is a dummy variable that serves to capture sustainable banks. It takes the value of 1 for the banks that have signed the UN Principles for Responsible Banking, and 0 otherwise. Sustainable banks are more transparent and have more stable returns and higher moral standards, and these characteristics allow them to manage risk more effectively [13,28]. As a result, we expect that the variable SB will have a significant and positive coefficient. The variables CONC, MS, XEF, and SEF have the same definitions as in Section 3.2.1.

To analyze how sustainable banks determine the effects of market power and efficiency on risk, in Equation (2) we included the interaction terms between the sustainable banks dummy (SB) and the variables CONC, MS, XEF, and SEF (SB × CONC, SB × MS, SB × XEF, and SB × SEF). The effects that CONC had on the risk of conventional banks (SB = 0) were measured by the coefficient β2. In the case of MS, XEF, and SEF, these effects were captured by the coefficients β4, β6, and β8, respectively. For sustainable banks (SB = 1), the effect of CONC on risk was measured by the sum of the coefficients (β2 + β3). In the case of MS, XEF, and SEF, this effect was reflected by the sums of the coefficients (β4 + β5), (β6 + β7), and (β8 + β9), respectively.

It is not clear what the expected signs of the coefficients β2 and β4 will be, nor the sums of the coefficients (β2 + β3) and (β4 + β5). On the one hand, banks with a larger market share that operate in more concentrated markets can reduce financial instability through the provision of greater capital reserves, which protect them against economic and

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liquidity shocks [99]. Large banks also have a comparative advantage in monitoring loans and can achieve greater diversification of both the loan portfolio and the geographical distribution [100]. On the other hand, a higher concentration can lead to an increase in interest rates on loans, so borrowers will have to undertake riskier projects to repay their loans [101]. Moreover, banks with a higher market share in concentrated markets are usually more protected by governments, which may lead them to take greater risks [102]. Conversely, more efficient banks tend to become more capitalized, which contributes to bank stability. At the same time, less efficient banks may be tempted to take on higher risks to compensate for increased costs and lost returns [103,104]. As a result, we expect that the coefficients $\beta6$ and $\beta8$, and the sums of the coefficients ($\beta6 + \beta7$) and ($\beta8 + \beta9$) will have a significant and positive sign.

The variable LOANS is the ratio of loans to total assets and captures the liquidity risk of the bank and its activity [78,79]. Because the variable LOANS represents the liquidity risk of the bank, there should be a negative relationship between LOANS and bank risk [105]. Nevertheless, the loan-to-assets ratio is also an indicator of banks' retail orientation. Retail banks are perceived as less risky than non-retail ones, especially during crises. Additionally, banks with higher levels of loans have a lower proportion of securities, which reduces their exposure to other risks, such as sovereign risk [106]. Therefore, we can also expect a positive and significant relationship between the variable LOANS and bank risk.

SIZE represents the size of the bank and is calculated as the natural logarithm of total assets (deflated) [81,82]. Larger banks are likely to have a higher degree of product and loan diversification than smaller banks, which reduces risk [37]. As a result, we can expect a positive relationship between SIZE and bank risk. However, a negative relationship between these two variables can also be expected because a larger size can lead to reduced efficiency in management, less effective internal control and increased organizational complexity, which can lead to higher operational risk [107].

LOANDEP controls for differences in the intermediation ratio and represents the ratio of loans to deposits [108]. When loans exceed the deposit base, banks face a funding gap for which they must access financial markets. Financial markets are more volatile than retail funding, so we expect a negative relationship between LOANDEP and bank risk [109]. Table 8 provides a summary of the independent variables included in Equation (2) and their expected relationships with risk.

Table 8. Summary of the independent variables of the risk analysis.

Variable	Description	Expected Relationship with Risk (Z)
SB	Dummy that takes the value of 1 if a bank has signed the UN Principles for Responsible Banking, and 0 otherwise	Positive
CONC	Herfindahl-Hirschman index (HHI) in terms of assets	Positive/Negative
MS	Market share in terms of assets	Positive/Negative
XEF	Cost X-efficiency	Positive
SEF	Scale efficiency with respect to the inputs	Positive
SB × CONC	Interaction between sustainable banks and market concentration	Positive/Negative
SB × MS	Interaction between sustainable banks and market share	Positive/Negative
SB × XEF	Interaction between sustainable banks and cost X-efficiency	Positive
SB × SEF	Interaction between sustainable banks and scale efficiency	Positive
LOANS	Loans/Total assets	Positive/Negative
SIZE	Log (Total assets)	Positive/Negative
LOANDEP	Loans/Deposits	Negative

Finally, year- and country-effect dummies were included to capture year- and country-specific factors. The error term is $\varepsilon_{i,t}$, and i = 1, 2, . . . , N indicates a specific bank i; t = 1, 2, . . . , T indicates a particular year t; and m = 1, 2, . . . , M indicates a particular country m. Table 9 presents the descriptive statistics of the variables used in the risk analysis, and Table 10 depicts the correlation between these variables.

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Table 9. Sample statistics of the risk analysis.

Variable	Mean	Standard Deviation	Minimum	Maximum
Z	95.9222	196.7297	0.1661	3975.0530
CONC	0.0792	0.0524	0.0306	0.2914
MS	0.0261	0.0570	1.69×10^{-6}	0.4602
XEF	0.8161	0.0579	0.3896	0.9470
SEF	0.7455	0.0998	0.0041	0.7813
LOANS	0.6340	0.1596	0.0195	0.9747
SIZE	8.9409	2.0031	3.1179	14.7620
LOANDEP	7.0419	398.6775	0.0202	30,647.1700

Table 10. Correlations of the risk analysis.

	CONC	MS	XEF	SEF	LOANS	SIZE	LOANDEP
CONC	1						
MS	0.5002	1					
XEF	−0.0792	−0.0906	1				
SEF	−0.0137	−0.2421	−0.0101	1			
LOANS	−0.1249	−0.1222	0.1223	0.1928	1		
SIZE	0.2204	0.4497	−0.0141	−0.4382	−0.1559	1	
LOANDEP	−0.0122	−0.0046	0.0146	0.0024	0.0020	0.0151	1

3.3.2. Methodology

Like the profitability analysis, the model in Equation (2) was estimated using two-step System-GMM with robust errors [21]. The year and country dummies were considered exogenous, while the remaining variables were considered endogenous. Based on the Hansen test of the over-identifying restrictions for the endogenous variables, in general second and third lags were used as instruments. To avoid over-identification problems based on the Hansen test, we used third and fourth lags for the variable MS in differences. The exogenous variables were instrumented by themselves. We also collapsed the instruments used in our estimation [92,93]. Moreover, we carried out the F-statistics test to assess instrument strength. These results, which are shown in Table 11, reveal that in general, the instruments provide significant explanatory power for the endogenous variables.

Table 11. First-stage OLS regressions for System-GMM estimates (risk analysis).

Z	F-Statistic	*p*-Value	R^2
Panel A. Dependent variable in levels, explanatory variables (instruments) in differences			
SB	255	0.0000	0.9832
CONC	40.4	0.0000	0.4481
SB × CONC	57	0.0000	0.9134
MS	42.6	0.0000	0.5859
SB × MS	58.4	0.0000	0.7958
XEF	30.6	0.0000	0.1327
SB × XEF	58.9	0.0000	0.9858
SEF	16.5	0.0000	0.5247
SB × SEF	6.5	0.0016	0.9371
LOANDEP	139.1	0.0000	0.2518
LOANS	13.5	0.0000	0.1401
SIZE	4.6	0.0099	0.3930
Panel B. Dependent variable in differences, explanatory variables (instruments) in levels			
ΔSB	22,235.2	0.0000	0.9344
ΔCONC	92.5	0.0000	0.4163
Δ(SB × CONC)	39.8	0.0000	0.5181
ΔMS	43.5	0.0000	0.4725

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Table 11. *Cont.*

Z	F-Statistic	*p*-Value	R^2
Δ(SB × MS)	6.9	0.0010	0.4924
ΔXEF	28.6	0.0000	0.0937
Δ(SB × XEF)	87.4	0.0000	0.2539
ΔSEF	59.3	0.0000	0.3643
Δ(SB × SEF)	75.7	0.0000	0.4049
ΔLOANDEP	366.4	0.0000	0.2561
ΔLOANS	42	0.0000	0.0904
ΔSIZE	82.3	0.0000	0.2020

3.3.3. Results of the Risk Analysis

Table 12 shows the results of the risk analysis. Regarding the objective of this analysis, the influence of sustainable banks, the variable SB is not significant, which suggests that sustainable initiatives do not alter bank risk. This does not support our Hypothesis 3.

Table 12. Results of the risk analysis.

	Coefficient	Standard Error	T-Student	*p*-Value
SB	2.1820	2.9806	0.73	0.464
CONC	−181.4364	159.8146	−1.14	0.256
SB × CONC	241.6333	485.7008	0.50	0.619
MS	−223.2634	180.3790	−1.24	0.216
SB × MS	−169.0902	340.5535	−0.50	0.620
XEF	173.6664	145.4064	1.19	0.232
SB × XEF	−178.9392	120.7129	−1.48	0.138
SEF	−87.7759	157.7984	−0.56	0.578
SB × SEF	137.3545	156.4459	0.88	0.380
LOANS	87.1793	2.2423	1.69	0.091 *
SIZE	15.7375	51.5945	1.93	0.054 *
LOANDEP	0.1084	2.2423	0.05	0.961
LR Test. SB × CONC	60.1970	474.8923	0.13	0.899
LR Test. SB × MS	−392.3537	298.9900	−1.31	0.189
LR Test. SB × XEF	−5.2728	139.2918	−0.04	0.970
LR Test. SB × SEF	49.5783	95.7228	0.52	0.605
CONS	−133.1983	156.7711	−0.85	0.396
Year dummies		Yes		
Country dummies		Yes		
M2				0.442
Hansen				0.102

* indicates a level of significance of 0.1. LR Test. SB × CONC is the linear restriction test of the sum of the coefficients associated with SB and CONC. LR Test. SB × MS is the linear restriction test of the sum of the coefficients associated with SB and MS. LR Test. SB × XEF is the linear restriction test of the sum of the coefficients associated with SB and XEF. LR Test. SB × SEF is the linear restriction test of the sum of the coefficients associated with SB and SEF. CONS is the regression intercept. M2 is the p-value of the 2nd order serial correlation statistic. Hansen is the p-value of the over-identifying restriction test.

As far as the control variables are concerned, the variable LOANS has a significant and positive coefficient, which denotes that banks with more loans are less exposed to risk [106]. Moreover, the variable SIZE also shows a significant and positive coefficient, so larger banks can achieve greater diversification, which reduces risk [37].

3.4. Discussion

This article analyses how sustainable practices affect bank profitability, both directly and through the market power and efficiency hypotheses. Moreover, it examines the impact of sustainable banking on insolvency risk.

Firstly, we find that sustainable banks obtain more profits. These results are in line with other studies that suggest that sustainable banks are more profitable than conventional

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banks. According to these studies, sustainable banks have a better reputation, provide more confidence, and can attract more loyal customers, which is why they earn superior profits [43,44].

Secondly, conventional banks that operate in more concentrated markets make more profits, as proposed by the market power hypothesis. Nevertheless, for sustainable banks, banking concentration does not affect profitability significantly. These results support the evidence of Matute-Vallejo et al. [8], which suggests that banks do not use sustainability as an attempt to instrumentalize social issues in a manner ultimately intended to increase prices. Instead of taking advantage of their market power to set higher prices for customers, sustainable banks would use other attributes to attract clients and earn profits, such as different business culture, lower reputational risk, or compromise with social and environmental values [2].

Thirdly, banks with superior cost scale efficiency are more profitable, regardless of their sustainable orientation, as the efficiency hypothesis suggest. The positive effects of sustainable strategies on efficiency would compensate for the negative ones and, hence, sustainable banks tend to be as efficient as conventional banks. The findings of many previous studies support this idea. On the one hand, Nidumolu et al. [9] reveal that social and environmental compromises are costly, which can reduce efficiency. On the other hand, as Bassen et al. [11] propose, these compromises can also improve the reputation of the banks that acquire them, which reduces their funding costs. Furthermore, Clarkson et al. [12] show that sustainable initiatives strengthen the sustainable standards of the industry, which raises competitors' costs.

Fourthly, our results show that sustainable banking practices do not have a significant impact on insolvency risk. According to García-Benau et al. [110], the financial crisis seriously damaged the reputation and the confidence of banks, which forced them to implement sustainable strategies despite their risks and costs. This aspect, along with the fact that real sustainability concerns have not emerged until recently, could explain why sustainable banks still do not exhibit lower insolvency risk.

4. Conclusions

The financial crisis had strongly adverse effects on the image and confidence of the banking sector, which led many banks to implement sustainable business strategies to improve their reputation. These strategies might affect the relationship between market power, efficiency, and profitability, as well as the relationship between sustainable banks and risk. To analyze these changes, we performed an empirical analysis on a sample of 1236 banks from 48 countries over the period 2015–2019. The results of this analysis indicate that sustainable banking practices lead to higher profitability. Moreover, conventional banks that operate in markets with higher concentration are more profitable, as proposed by the market power hypothesis. However, for sustainable banks, market concentration does not affect profits significantly. Higher levels of cost scale efficiency lead to more profitability for both conventional and sustainable banks. There does not appear to be a significant relationship between sustainable banks and risk.

These results have important implications for the implementation of sustainable business models and the research agenda for sustainability in banking. Our results suggest that the traditional determinants of bank profitability are not relevant in explaining the superior profits made by sustainable banks. This suggests the emergence of a new paradigm related to sustainability in the drivers of bank profitability, where intangible competitive advantages such as brand image, customer loyalty, lower reputational risk, or ethical issues could play a key role.

Moreover, sustainable activities still do not affect bank risk, probably because the severe consequences of the financial crisis forced banks to adopt a sustainable approach regardless of their risks. It is possible that sustainable practices will reduce bank risk in the future when banks will have completely restored their image and the confidence lost during the 2008 financial crisis.

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On the other hand, our sample includes banks from many world regions with differences in regulation, which could also determine the relationship between sustainability and the market power and efficiency hypotheses, as well as the relationship between sustainability and credit risk. For instance, regulatory factors and legal requirements can have important effects on bank efficiency and solvency. Additionally, legal impediments to competition can alter the degree of concentration. Further research is therefore needed to fully understand the determinants of profitability and risk among sustainable banks, especially in the long run.

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Appendix A

To estimate cost efficiency, we used the Fourier flexible functional form under the alternative specification. We estimated the efficiency frontier using the stochastic frontier approach (SFA). In addition, we followed the intermediation approach that considers three outputs, three input prices, financial capital (equity) as a correction factor and four environmental variables [7,74,111–113]. We also incorporated the time trend as a measure to control for technological progress [114]. Our specification of the cost function is as follows:

$$
\begin{aligned}
\ln(C) = {} & \alpha + \sum^{3}_{i=1}\beta_i \ln(w_i) + 1/2\sum^{3}_{i=1}\sum^{3}_{j=1}\beta_{ij}\ln(w_i)\ln(w_j) + \sum^{3}_{k=1}\gamma_k \ln(y_k) + \\
& 1/2\sum^{3}_{k=1}\sum^{3}_{n=1}\gamma_{kn}\ln(y_k)\ln(y_n) + \omega\ln(E) + 1/2\psi\ln(E_i)^2 + \tau_1 T + 1/2\tau_2 T^2 + \sum^{3}_{i=1}\sum^{3}_{k=1}\rho_{ik} \\
& \ln(w_i)\ln(y_k)\sum^{3}_{i=1}\eta_{iE}\ln(w_i)\ln(E) + \sum^{3}_{i=1}\zeta_i T\ln(w_i) + \sum^{3}_{k=1}\rho_{kE}\ln(y_k)\ln(E) + \\
& \sum^{3}_{m=1}\sum^{3}_{k=1}\vartheta_k T\ln(y_k) + \sum^{4}_{s=1}\mu_k\ln(v_s) + \sum^{4}_{q=1}[\varphi_q\cos(x_q) + w_q\sin(x_q)] + \sum^{4}_{q=1}\sum^{4}_{r=1}[\varphi_{qr}\cos(x_q + x_r) \\
& + w_{qr}\sin(x_q + x_r)] + \sum^{4}_{q=1}[\varphi_{qqq}\cos(x_q + x_q + x_q) + w_{qqq}\sin(x_q + x_q + x_q)] + \ln u + \ln\varepsilon
\end{aligned}
$$

The dependent variable is total cost (interest and non-interest expenses).

Outputs:

1. y1 = loans.
2. y2 = securities.
3. y3 = deposits.

Input prices:

1. w1 = cost of lendable funds: interest expenses over liabilities (deposits, money market funding and other funding).
2. w2 = cost of physical capital: defined as the ratio of non-interest expenses and the book value of physical capital.
3. w3 = cost of labor: operating expenses to total employees.

Fixed netput:

E = financial capital (equity).

Environmental variables of the country:

1. v1 = outstanding loans from commercial banks to GDP.
2. v2 = per capita GDP.
3. v3 = population density.

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4. v4 = Herfindahl concentration index to assets.

Time trend:

T = time trend.

The variables x_q, q = 1, 2, 3, 4 are rescaled values of the variables (lny_k), k = 1, 2, 3, and ln(E) such that x_q is in the [0.2π] interval, where π is the number of radians and not the profits. Moreover, we cut 10% off each end of the [0.2π] interval such that the x_q span is [0.1 × 2π, 0.9 × 2π]. This eliminates problems of approximation to the extremes. The formula for x_q is 0.2π − μ × a + μ × variable, where μ ≡ (0.9 × 2π − 0.1 × 2π)/(b − a), and [a, b] is the range of the variable.

Because the duality theorem requires that the cost function is linearly homogeneous in input prices and continuity requires that the second-order parameters are symmetric, the following restrictions apply to the parameters:

$$\sum\nolimits^{3}{}_{i=1}\beta_i = 1; \sum\nolimits^{3}{}_{i=1}\beta_{ij} = 0; \sum\nolimits^{3}{}_{i=1}\rho_{ik} = 0; \sum\nolimits^{3}{}_{i=1}\eta_{im} = 0$$

The inefficiency term is assumed to be distributed as half-normal.

$$\beta_{ij} = \beta_{ji}; \gamma_{ik} = \gamma_{ki}$$

Appendix B

We estimated the scale economies by deriving the cost function with respect to the inputs:

$$SCALE = \sum\nolimits^{3}{}_{n=1}(\delta lnC/\delta lny_i)$$

This measure was calculated with the mean of the input and output values in various size classes [7,76] and for each of the years analyzed. We considered six intervals: (1) less than $500 m; (2) between $500 m and $1 bn; (3) between $1 bn and $3 bn; (4) between $3 bn and $5 bn; (5) between $5 bn and $10 bn; and (6) more than $10 bn.

A bank operates under increasing, constant, or decreasing returns to scale when this measure is greater than, equal to, or less than 1, respectively.

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